



King Saud University
Journal of Saudi Chemical Society

www.ksu.edu.sa
www.sciencedirect.com



ORIGINAL ARTICLE

Contents of heavy metals in lotus seed from REEs mining area

Cai Dingjian *

Institute of Material and Chemistry Engineering, University of Science and Technology, Ganzhou City, Jiangxi Province 341000, PR China

Received 6 December 2010; accepted 24 December 2010
Available online 5 January 2011

KEYWORDS

Heavy metal;
Lotus seeds;
Soil;
Rare earth elements (REEs)
mining area;
ICP-MS

Abstract At rare earth mining area, the pollution of heavy metals has been paid little attention. In lotus seeds and soil samples sampled from a typical rare earth elements mining area were detected the contents of eight kinds of heavy metals (Cr, Mn, Cu, Zn, As, Cd, Hg and Pb) to investigate the pollution from rare earth elements mining by ICP-MS (Inductively Coupled Plasma Mass Spectrometry). The results showed that the contents of the heavy metals Cr, Mn, Cu, Zn, As, Cd, Hg and Pb in lotus seeds were 0.25, 86.94, 8.32, 19.76, 0.13, 0.08, 0.01, and 0.20 $\mu\text{g/g}$ in lotus seeds, respectively, and corresponding contents in soil were 27.68, 168.71, 20.23, 47.16, 1.83, 0.13, 0.04, and 23.15 $\mu\text{g/g}$. These data showed that the contents of heavy metals in lotus seeds from REEs mining area are no higher than reference area and meet national food safety standards of China.

© 2011 King Saud University. Production and hosting by Elsevier B.V.
Open access under [CC BY-NC-ND license](#).

1. Introduction

At rare earth elements mining area, most attention was paid on the pollution, distribution, accumulation and transportation of rare earth elements in local plant and crop (Wei et al., 2001a,b). Some researches proved that rare earth mining can strip topsoil and minerals containing heavy metals, can pollute the soil and water by rainfall and surface runoff (Yang and Shuai, 2009). But we have not found paper about heavy metals pollution in rare earth mining, and we have no more international experience for reference because most REEs mining and production was done in China, which covers ninety percent of rare earth export in the world.

In this paper, lotus seeds and soil from rare earth mining area were investigated; eight kinds of heavy metals were detected to determine whether there is heavy metal pollution and its degree of pollution.

* Tel.: +86 13307076865.
E-mail address: caidingjian2010@hotmail.com.



Table 1 Correlation coefficient, limits of detection and relative standard deviations of detected heavy metal elements.

Heavy metals	Correlation coefficient	Limits of detection ($\mu\text{g/L}$)	Relative standard deviations (RSD, %)
Cr	0.987	0.10	2.77
Mn	0.999	0.24	2.65
Cu	0.994	0.36	1.87
Zn	0.991	0.57	1.69
As	0.940	0.71	8.34
Cd	0.999	0.09	2.32
Hg	0.879	0.69	7.68
Pb	0.999	0.11	1.07

Table 2 Contents of the heavy metals in soil and lotus seeds from REEs mining area ($\mu\text{g/g}$).

Elements	Lotus seeds	Soil
Cr	0.25	27.68
Mn	86.94	168.71
Cu	8.32	20.23
Zn	19.76	47.18
As	0.13	1.83
Cd	0.08	0.13
Hg	0.01	0.04
Pb	0.20	23.15

2. Materials and methods

2.1. Materials and instruments

Lotus seeds and topsoil (0–30 cm) are sampled from south of Jiangxi province of China. The ICP-MS instrument was the PQ Excell instrument (PE Company, USA).

2.2. Experimental method

Sample preparation and instrument parameters to detect the contents of heavy metals in lotus seed and soil referred to Rui's (2006 and 2009) and Zhang's (Zhang and Rui, 2010) methods.

3. Results and analysis

Correlation coefficients of all detected eight kinds of heavy metals ranged from 0.879 to 0.999, limits of detection of detected rare earth elements were between 0.09 and 0.71 $\mu\text{g/L}$, and the RSDs (Relative Standard Deviations) ranged from 1.07% to 8.34% (Table 1), only As and Hg were 8.34% and 7.68%, respectively, which were higher than 2.80%. The above data proved that ICP-MS was accurate and precise to detect these eight heavy metals in lotus.

Contents of the heavy metals Cr, Mn, Cu, Zn, As, Cd, Hg and Pb in lotus seeds were 0.25, 86.94, 8.32, 19.76, 0.13, 0.08, 0.01, and 0.20 $\mu\text{g/g}$, respectively, and corresponding contents in soil were 27.68, 168.71, 20.23, 47.16, 1.83, 0.13, 0.04, and 23.15 $\mu\text{g/g}$ (Table 2). These data showed that contents of heavy metals in lotus seeds from REEs mining area are no higher than reference area and safe. (Yao and Wang, 2006; Lin et al., 2005)

4. Conclusions

- (1) Heavy metals in lotus seeds could be detected accurately and precisely by ICP-MS simultaneously.
- (2) Contents of heavy metals in lotus seeds from REEs mining area are no higher than reference area and meet national food safety standards of China (GB2762, 2005).

Acknowledgement

We thank Ms. Ouyang Li (School of public health, Peiking University, China) for help detecting.

References

- Lin, S.C., Ye, G.W., Wu, J.Z., Zheng, Y.B., Lin, W.X., 2005. Studies on the Comparison of the Chemical Compounds in Lotus Seeds (*Nelumbo nucifera Gaertn.*) Between "Tai-Kong lotus 36" and "Jian lotus". Strait Pharmaceutical Journal 17 (4), 91–93.
- National Standards of PR China, Maximum levels of contaminants in food, GB2762-2005.
- Rui, Y.K., Jiang, S.L., Zhang, F.S., Shen, J.B., 2009. Effects of nitrogen fertilizer input on the composition of mineral elements in corn grain. Agrociencia 43, 21–27.
- Rui, Y.K., Zhang, H.X., Guo, J., Huang, K.L., Zhu, B.Z., Luo, Y.B., 2006. Heavy metals content in transgenic soybean oil from Beijing Market. Agro FOOD industry hi-tech 17 (2), 35–36.
- Wei, Z.G., Wan, S.K., Zhang, X., Hong, F.S., Zhao, G.W., Tao, Y., Wang, Z.L., Xie, X.Q., 2001b. ICP-AES studies on characteristics of distribution, accumulation and transportation of rare earth elements in soil-Dicranopteris dichotoma system. China Journal of Applied Ecology 12 (6), 863–866.
- Wei, Z.G., Yin, M., Zhang, X., Hong, F.S., Li, B., Tao, Y., Zhao, G.W., Wang, Z.L., Xie, X.Q., 2001a. Distribution, accumulation and transportation of rare earth elements in soil-Dicranopteris linearis system at South Jiangxi. Acta Ecologica Sinica 21 (6), 900–906.
- Yang, M., Shuai, Z.Q., 2009. Development of rare earth industry in Maoniuping and research on countermeasure of environmental protection. Sichuan Environment 28 (1), 105–109.
- Yao, S.M., Wang, Q., 2006. Determination of lead, mercury and cadmium in six kinds of restorative Chinese herbs in common use. Geoscience 13 (3), 50–52.
- Zhang, H.X., Rui, Y.K., 2010. Determining mineral elements in four kinds of grains from Beijing market by ICP-MS simultaneously. Journal of Saudi Chemical Society doi: 10.1016/j.jscs.2010.10.014.